REMARKS

Examiner N. Berezny is thanked for his thorough examination of the Prior Art.

Favorable reconsideration of this application in light of the above amendments and the following remarks is respectfully requested.

The invention teaches the deposition of a pattern of interconnecting lines and bond pads. Passivation layers are deposited over this metal pattern. A layer of photosensitive polyimide is deposited over the passivation layers. This layer of photosensitive polyimide is patterned, exposed and developed, the passivation layer is patterned and etched to expose the underlying bonding pads. The remaining polyimide is cured and cross-linked and remains in place to serve as a buffer during further device packaging.

Claim rejections - 35 U.S.C. § 103(a)

Reconsideration of the rejection of claims 1-25 and 27-30 under 35 U.S.C 103(a) as being unpatentable over Dass et al. (US

Patent 6,143,668) in view of Fu et al. (US Patent (5,807,787) is respectfully requested based on the following.

In order to facilitate comparison of the invention with Dass et al. in view of Fu et al, the essential points of the invention are first summarized, as follows:

- the instant invention starts with a semiconductor surface, typically the surface of a semiconductor substrate, over which a pattern of metal has been created, including interconnect lines and bonding pads
- a first layer of passivation is deposited over the semiconductor surface including the surface of the metal patterns
- a second layer of passivation is deposited over the first layer of passivation
- a thick layer of polyimide is deposited over the surface of the second layer of passivation
- the thick layer of polyimide is patterned and etched creating openings in the layer overlying the surface of the bonding pads, leaving the polyimide in place above the interconnect line pattern,
- the layers of passivation are etched, exposing the surface of the bonding pads, and

- the thick layer of polyimide is cured and cross-linked in order to provide improved protection for the interconnect metal.

Dass et al. start with a semiconductor surface, typically the surface of a semiconductor substrate, over which a bonding pad is provided. No pattern of metal interconnect lines has been created over the substrate used by Dass et al. This as opposed to the interconnect lines 12, Fig. 8 of the invention that are created overlying the surface of a substrate and adjacent to a bond pad 14. This latter difference is of key value to the invention, since it allows the creation of an opening to the bond pad while adjacent layers of interconnect are protected from etching effects (by the overlying and protective layer 36 of photosensitive polyimide). See also claims 1 "interconnect metal for interconnect lines and top level bond pad", claim 20: "a wiring layer having wiring and having a plurality of bond pads". Dass et al. therefore do not provide for the problem of surface damage to the passivation layer of interconnecting metal lines. This latter point is further evidenced by a comparison of the final structures created by Dass et al. and the instant invention. That is by comparing Fig. 15, Dass et al. with Fig. 9 of the instant invention. Dass et al. has not addressed the occurrence of keyholes, element 20, Fig. 8 of the invention,

between closely spaced layers of interconnect metal, whereby the close spacing will be an ever increasing phenomenon for sub-micron devices.

Since Dass et al. do not provide for a thick layer of polyimide, layer 48, Fig. 9, overlying interconnect traces 12, Fig. 9. Dass et al. also do not provide for (excellent) protection of the passivation film (by the thick layer of polyimide) that remains in place above the interconnecting lines.

Examiner cites Dass et al., col. 1, lines 26-29, as providing top level interconnect lines and top level pads. In the referenced text Dass et al. are discussing Fig. 1, which refers to Prior Art methods and which therefore has no bearing on the invention provided by Dass et al. All references to Dass, which are cited by examiner, relate to describing prior art methods as shown in Figs. 1-11 in the Dass et al. disclosure and therefore have no bearing on the Dass et al. invention. For these prior art methods, most typically Fig. 8 (the completed structure of the prior art), it is again apparent that the cited prior art does not disclose the creation of a bond that overlies a surface over which interconnect traces have been created, as specified in claims 1 and 20 of the instant invention. The prior art that

is cited by Dass et al. therefore also does not provide for the advantages of the invention that have been highlighted above.

The method that is provided by Dass et al. addresses problems that are experienced with, col. 4, lines 55 e.a., "the passive scrub cantilever needle probe card and the scrubbing process", problems that become particularly acute for smaller contact pad pitch for contact pads that are used for, col. 5, line 10 e.a.: "consistently testing or probing of wafers." The pads that are therefore created by Dass et al. are wafer contact pads for testing purposes having a pitch, col. 5, line 17 e.a., of 80 microns.

Fu et al. address only bonding pads, the instant invention addresses bonding pads that are provided on the surface of a substrate concurrent with interconnect lines. The difference is significant since, in forming a thick layer of passivation (for improved protection of the underlying components) in the era of sub-micron devices and the therewith used closely spaced interconnect lines, keyholes between interconnect lines are a problem since the thick layer of passivation (typically deposited by depositing two layers of passivation) does not readily penetrate between narrowly spaced adjacent interconnect lines. For a typical process of etching (a passivation layer in

order to expose a bonding pad), photoresist is used which, where keyholes are present (that is most typically between adjacent interconnect traces), penetrates the keyholes and, during subsequent high temperature processing, violently reacts to the high temperatures and "explodes" from the keyholes, causing significant disturbance to the process of device formation. This is to be prevented, the present invention prevents this by using a thick layer of polyimide whereby the polyimide readily penetrates any keyholes that may have formed between adjacent, closely spaced interconnect lines. With the invention, bond pads can be created without incurring processing damage by photoresist remnants that in conventional processing penetrates into keyholes between closely spaced interconnect lines.

Fu et al. deposit a layer of passivation and etch this layer (exposing the surface of the bonding pad) before depositing a layer of polyimide. The instant invention deposits the (two layers of) passivation over which the layer of polyimide is deposited. After these layers have been deposited, the polyimide is etched after which the layer of passivation is etched. The difference in sequence is significant because the instant invention first provides protection to the interconnect lines after which a bonding pad is created. Fu et al. create a bonding pad by first creating an opening in the layer of passivation

(exposing the bonding pad) after which a layer of polyimide is deposited. The layer of polyimide contacts the surface of the bonding pad, the layer of polyimide is etched again exposing the bonding pad. The etch of the polyimide leaves polyimide in place over the surface of the bonding pad (Fu et al., col. 6, line 1 e.a.) which is further removed with the additional step of oxide ashing (Fu et al, see table in col. 6, lines 6-14).

What makes the instant invention unique and therefore patentable over Dass et al. in view of Fu et al. is that neither one of these two inventions addresses the creation of a bond pad that has been provided over a semiconductor surface over which a network of interconnect traces has also has been provided. The bond pad can be accessed (exposed), leaving the interconnect traces covered and protected. Prior art processing required, in order to achieve this objective, the application of layers of photoresist with the potential of forming deposits of photoresist in keyholes between adjacent layers of interconnect traces, leading to the (potentially catastrophic) results that have been highlighted above. The invention eliminates negative effects previously created in exposing a bond pad, pad 14, Fig. 9 of the invention, which is created on a surface over which also interconnect traces, lines 12, Fig. 9, have been created, as further specified in claims 1 and 20 of the invention.

While applicant acknowledges the teachings of Dass et al. and Fu et al. as cited by the Examiner, and although applicant does not necessarily agree that the Examiner's arguments show sufficient and proper basis for suggestion or motivation to modify or combine Dass et al. with Fu et al., applicant nonetheless also asserts that there is absent within the portions of Dass et al. and Fu et al. of any combination thereof, as cited by the Examiner, an express or inherent teaching of each and every limitation within applicant's invention as taught and claimed within claims 1 and 20 and the supporting dependent claims of the invention.

It would not be obvious to combine the teachings of Dass et al. with those of Fu et al., since there is no suggestion or motivation in the teachings of any of the patents of the present invention. Contrary to the Examiner's assertion that the method of Fu et al. can be combined with the method of Dass et al. for forming bonding pads, neither one of these inventions addressed exposing of a bonding pad that is created over the same surface over which also interconnect traces have been created. The invention is believed to be patentable over the prior art cited, as it is respectfully suggested that the combination of these various references cannot be made without reference to Applicant's own invention. Neither one of these inventions

therefore, taken alone or in combination, address the problems of surface damage to the passivation layer of interconnecting metal lines, the problem of providing a surface stress buffer over a pattern of interconnect lines while not having to remove photoresist, the problem of SOG planarization in creating interconnect traces in combination with bonding pads (prior art typically uses a layer of SOG to avoid key hole formation, see element 30, Fig. 7), the problem of SOG surface cracking and delamination (a prior art problem for applications where a bond pad and interconnect traces are provided over the same surface, see Fig. 7 of the instant invention), the problems of an additional polyimide process to reduce stress impact on the surface of the passivation layer of the bonding pad and the problems of keyhole formation.

Applicant has claimed his process in detail. The processes of the invention, as claimed in claims 1 and 20, are both believed to be novel and patentable over Dass et al. in view of Fu et al., because there is not sufficient basis for concluding that the combination of claimed elements would have been obvious to one skilled in the art. That is to say, there must be something in the prior art or line of reasoning to suggest that the combination of these various references is desirable. We believe that there is no such basis for the combination.

In light of the foregoing response, applicant respectfully requests that the Examiner's rejection of claims 1-25 and 27-30 under 35 U.S.C 103(a) as being unpatentable over Dass et al. (US Patent 6,143,668) in view of Fu et al. (US Patent (5,807,787) be withdrawn.

Other Considerations

No new independent or dependent claims have been written as a result of this office action, no new charges are therefore incurred due to this office action.

SUMMARY

The invention teaches the deposition of a pattern of interconnecting lines and bond pads. Passivation layers are deposited over this metal pattern. A layer of photosensitive polyimide is deposited over the passivation layers. This layer of photosensitive polyimide is patterned, exposed and developed, the passivation layer is patterned and etched to expose the underlying bonding pads. The remaining polyimide is cured and cross-linked and remains in place to serve as a buffer during further device packaging.

It is requested that should Examiner not find the claims to be allowable that he call the undersigned Attorney at his convenience at 845-452-5863 to overcome any problems preventing allowance.

Respectfully submitted,

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